Published in final edited form as:
J Occup Environ Med. 2013 August ; 55(8): 973–977. doi:10.1097/JOM.0b013e318297325b.

Are operating room nurses at higher risk of severe persistent asthma?:

The Nurses' Health Study

Nicole Le Moual, PhD[1,2], **Raphaëlle Varraso, PhD**[1,2], **Jan Paul Zock, PhD**[3,4,5], **Paul Henneberger, ScD**[6], **Frank E Speizer, MD**[7], **Francine Kauffmann, MD**[1,2], and **Carlos A Camargo Jr, MD, DrPH**[7,8]

[1]Inserm, Centre for research in Epidemiology and Population Health (CESP), U1018, Respiratory and environmental epidemiology Team, F-94807, Villejuif, France

[2]Univ Paris Sud 11, UMRS 1018, F-94807, Villejuif, France

[3]Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain

[4]Hospital del Mar Research Institute (IMIM), Barcelona, Spain

[5]CIBER Epidemiología y Salud Pública (CIBERESP), Spain

[6]National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, USA

[7]Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, USA

[8]Department of Emergency Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, USA

Abstract

Objective—To assess the associations between operating room (OR) nursing, a category of health care workers at high risk of exposure to various inhaled agents, and asthma severity/control among women with asthma.

Methods—The level of severity/control in nurses with prevalent doctor-diagnosed asthma in 1998/2000 was compared, using nominal logistic regression, in OR nursing (n=69) and administrative nursing (n=546) from the US Nurses' Health Study for whom detailed information on asthma and nursing employment status was available.

Results—We observed a significant association between OR nursing, compared to administrative nursing, and severe persistent asthma (adjusted odds ratio 2.48, 95%CI 1.06–5.77).

Conclusions—Our findings suggest that nurses working in the operating room are at a higher risk of severe persistent asthma. Further studies with detailed estimates of occupational exposures, especially to disinfectant/cleaning agents, are warranted.

Address manuscript correspondence to: Nicole Le Moual, Inserm U 1018 / CESP, Centre for Research in Epidemiology and Population Health, Respiratory and Environmental Epidemiology, 16, avenue Paul Vaillant Couturier, 94807 Villejuif Cedex, France, nicole.lemoual@inserm.fr, Tel: + 33 1 45 59 50 70, Fax: + 33 1 45 59 51 69.

Conflicts of Interest
The authors do not have any conflicts of interest.

Disclaimer
The findings and conclusions in the report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Keywords

operating room nurse; occupation; asthma severity; epidemiology

Introduction

Operating room (OR) nurses are known to be at higher risk for occupational injuries, work-related stress and particularly high exposure to various toxic agents including infectious agents, radiation, noise, latex gloves and anesthetic gases, among healthcare workers (1–3). OR nurses have also been identified as one of the highest exposed group to disinfectant/cleaning agents as compared to those working in other hospital units (4). Regarding diseases, besides well-described skin disorders, reproduction disorders, infectious diseases, musculoskeletal complaints and occupational injuries (1), relatively little attention has been paid to the association between OR nursing and respiratory diseases such as asthma (2).

Healthcare workers account for a significant component of the United States (US) workforce especially among women (5). Disinfectants and cleaning agents make a deleterious contribution to asthma prevalence in healthcare workers, particularly for nurses (6, 7). Some specific disinfectants/cleaning agents used by female hospital workers have been reported strongly associated with current asthma (8). Nurses have been identified at increased risk of occupational asthma (9), adult-onset asthma (10), and asthma exacerbation (11). In these studies, nurses were often compared to worker groups with potentially heterogeneous socioeconomical status (10–12). In addition, data on the association between occupational exposure and asthma severity/control remain sparse (11, 13, 14). No study has evaluated the association between employment as an OR nurse, who may be specifically at high risk of exposure, and asthma severity/control.

The US Nurses' Health Study (NHS), an ongoing prospective cohort study of female registered nurses, is a unique opportunity to study OR nurses (2). In the present study, we sought, among women with prevalent asthma, to examine the association between employment as an OR nurse with the level of asthma severity/control, by comparing OR nurses to administrative nurses, women of otherwise similar professional training and socio-economic status.

Methods

The Nurses' Health Studybegan in 1976 when 121,700 female nurses aged 30–55 years and living in 11 US states responded to a mailed health questionnaire (15). Follow-up questionnaires on lifestyle factors and newly diagnosed medical conditions, including asthma, are sent biennially. The study has institutional review board approval and is being conducted according to the ethical guidelines of Brigham and Women's Hospital (Boston, USA).

In 1992, information was requested on current work status, with options including full-time and part-time nursing (OR nursing, inpatient or emergency room nursing, outpatient or community nursing, nursing education, nursing administration, other nursing), non-nursing employment, homemaker and retired. The 1996 questionnaire included questions about current work (retired, homemaker, non-nursing employment, nursing), allowing an update of the 1992 job status for retirement and women who had become full-time homemakers. No information on OR nursing status was available at the time asthma status was evaluated in detail. For the present analysis, we combined nursing education and nursing administration into one group, hereafter referred to as administrative nurses.

In 1998 and 2000, a supplemental questionnaire on asthma was sent to every participant who reported a prevalent physician's diagnosis of asthma prior to 1996 (using biennial information). It collected information confirming a physician's diagnosis of asthma, as well as the dates of symptom onset and diagnosis, asthma symptoms, medications and hospitalizations for asthma. Based on these detailed questionnaires, we defined persistent doctor-diagnosed asthma using the following definition of asthma: 'participant reiterated on the supplementary questionnaire that a physician had diagnosed her as having asthma, and she reported using an asthma medication since diagnosis' (previously described as 'asthma definition 1' (16)). All nurses with a concomitant diagnosis of chronic obstructive pulmonary disease (COPD) were excluded from the present analyses. As described previously (17), we used a definition of asthma severity (outcome variable) that divided participants into four mutually exclusive groups: mild intermittent (used as the reference), mild persistent, moderate persistent and severe persistent. This classification system was based on the 1997 U.S. National Institutes of Health asthma guidelines (18), and took into account (17): 'days kept from work or usual activities within the past 12 months', 'days per week with wheeze or whistling sound in chest, shortness of breath, or cough over the past 4 weeks', and 'breathing between asthma flares over the past 4 weeks' (see Table 2). According to current recommendations (19, 20), this definition of severity is better thought of in terms of 'asthma control' or 'asthma severity/control' and we have used the term 'asthma severity/control' in our paper.

In the present analyses, women currently working in 1992 as an OR nurse were compared to administrative nurses, who were considered a non-exposed reference group. Among OR (n=1054) and administrative (n=7661) nurses currently working in 1992, 616 had persistent asthma in 1998. Among them, we included OR (n=69) and administrative (n=546) nurses in 1992 for whom it was possible to determine the level of asthma severity (n=615, see Figure 1). For a sensitivity analysis (n=437), we further excluded 179 women who became homemakers or retired during 1992 till 1996.

Thus, we examine, among women with prevalent doctor-diagnosed asthma, the cross-sectional association between reported employment as an OR nurse in 1992 and asthma severity/control in 1998/2000 (outcome in four categories) by using polytomous logistic regression, with calculation of odds ratios and 95% confidence intervals. Models were adjusted for age (in quantitative), body mass index (in quantitative) and smoking habits. All analyses were conducted using SAS, version 9.1 (SAS Institute, Inc., Cary, North Carolina, USA).

Results

Table 1 describes the characteristics of the population in 1992, according to nursing status: OR *vs* administrative nursing. Women had an average age of 54 years in 1992. Characteristics of the studied population were similar in the OR and administrative nursing groups regarding age, race/ethnicity, menopausal status, body mass index, smoking habits, and having had a recent physician examination.

Table 2 shows that nurses with prevalent asthma were on average about 60 years old in 1998. Characteristics of the studied population were similar in the OR and administrative nursing groups regarding reported allergy and taking a medication for asthma (not shown). After adjustment for age, the association between OR nursing, compared to administrative nursing, and doctor's visits for urgent treatment of asthma within the past twelve months remained significant (odds ratio 1.83, 95%CI 1.04–3.21). When studying asthma severity/control (Table 3), using mild intermittent asthma as the reference group, no association was observed between OR work and moderate persistent asthma, whereas a statistically

significant association was observed with severe persistent asthma (odds ratio 2.50, 95%CI 1.12–5.57). Further analysis was adjusted for age, smoking habits, and body mass index and the association remained statistically significant.

To further examine this finding, we performed a sensitivity analysis that excluded the nurses who became homemakers or retired between 1992 and 1996. Similar results were observed in this smaller sample (n=437), with statistically significant associations with the number of days kept from work or usual activities within the past 12 months (odds ratio 1.84, 95%CI 1.01–3.37) and occurrence of breathing symptoms between asthma flares most of the time over the past 4 weeks (odds ratio 3.06, 95%CI 1.07–8.75). A borderline significant association was observed for doctor's visits for urgent treatment of asthma within the past 12 months (odds ratio 1.78, 95%CI 0.93–3.41, p=0.07). Similar odds ratios (adjusted only for age because of the relatively small sample) were observed for the OR nurses, compared to administrative nurses, for the comparison of intermittent asthma (reference group) versus mild persistent (odds ratio 1.36, 95%CI 0.66–2.77), moderate persistent (odds ratio 0.67, 95%CI 0.28–1.57) and severe persistent asthma (odds ratio 3.68, 95%CI 1.32–10.28).

Discussion

We observed clinically and statistically significant associations between OR nursing and severe persistent asthma. We investigated for the first time the association between OR nursing and asthma. The results call for further studies that more directly examine the adverse impact of OR work on major respiratory diseases, such as asthma.

A recent literature review on the 'risks and health effects in operating room personnel'(1) emphasized that OR nurses have particularly high exposure to various hazards, including infectious agents, radiation, noise, latex gloves and anaesthetic gases, but did not discuss exposure to disinfectant/cleaning agents, an inhaled exposure that has been previously identified among nurses (9). Among healthcare workers, OR nursing was judged by experts to be one of the highest exposed group (in addition to emergency room and intensive care unit nurses) to disinfectant/cleaning agents, a common and regular exposure in hospitals (4, 21). OR workers are exposed to other toxic agents including latex gloves and anesthetic gases (1) that are less commonly encountered in other units. They may also differ from those working in administrative units for other possible exposures (e.g., work-related stress) but it was not possible to take into account such exposures in the present analysis. Various disinfectant/cleaning agents are used every day by healthcare workers for healthcare hygiene and the frequency of disinfecting/cleaning tasks has increased in recent years in an effort to protect patients from nosocomial infections (4). This exposure may represent an important public health issue, especially in women, who are more exposed to these kinds of products than are men (4, 22, 23).

Our current results, on the association between OR nursing and asthma severity/control in American nurses, are consistent with results from European studies. In the French Epidemiological study on the Genetics and Environment of Asthma (EGEA) (14), a strong association between occupational exposure to cleaning agents and asthma severity was evidenced (odds ratio 7.2, 95%CI 1.3–39.9), when comparing subjects with adult-onset asthma to those without asthma. In the European Community Respiratory Health Survey, Henneberger et al., comparing healthcare nurses to white collar jobs among adults with current asthma, observed an association of borderline significance (RR 1.7, 95%CI 0.99–2.9) with severe exacerbation of asthma (as defined by emergency treatment, use of oral steroids, or hospitalization overnight for breathing problems) (11). We observed, as expected, an increase in odds ratios for the association between OR nursing and asthma

severity/control when we excluded women who had become homemakers or retired by 1996.

For women with mild persistent asthma, the lack of association is consistent with results from EGEA (14) where the comparison of mild adult-onset asthma to those without asthma led an odds ratio of 1.2. One hypothesis was that asthma caused or exacerbated by work exposures quickly becomes severe due to persistent exposure, thus making it difficult to "detect" an association between exposure and the mild phase of the disease (14, 24). The non-significant odds ratio below one that we observed for moderate persistent asthma in NHS might be explained by a healthy survivor effect (25). For example, one can hypothesize that the asthma of nurses who changed jobs became moderate while the asthma of those who stayed in the same job became severe.

Regarding asthma status in the Nurses' Health study, a previous validation study confirmed 95% of the nurses' reports of doctor-diagnosed asthma (16). Furthermore, to limit misclassification error, all nurses with a concomitant diagnosis of COPD were excluded from the present analyses. Although asthma severity is difficult to define in epidemiology, the use of severity scores, following international guidelines, has made it possible to evaluate the role of risk factors (14, 26).

We observed a higher proportion of 'days kept from work or usual activities' among the OR compared to administrative nurses (p=0.09). Respiratory work disability has been scarcely studied (27, 28) and has been shown to be associated with asthma severity (29). One recent study reported more respiratory-related absence from work (in the past year) in healthcare workers than in the general population (30).

The Nurses' Health Study is an ongoing cohort of registered nurses with high response rates (consistently >90% in the NHS cohort) which minimized selection bias (2). We evaluated asthma severity/control through a specific questionnaire on asthma status. A limitation of our study relates to the cross-sectional analysis as we evaluated severity/control among participants with persistent doctor-diagnosed asthma in 1998/2000, without information available regarding the evolution of asthma severity/control. The lack of information regarding OR nursing status, at the time asthma status was evaluated in detail, is also a limitation. To limit the effect of this misclassification bias, we performed a sensitivity analysis that excluded the nurses who became homemakers or retired between 1992 and 1996, and similar results were observed. In a study among healthcare workers, results from Delclos et al suggested a differential misclassification bias in occupational exposures evaluated by self-report (31). Differential misclassification of exposure is less likely to be present when using less subjective estimates such as job status or job-exposure matrices (31, 32). Therefore, the odd ratio observed in the present study might be underestimated due to non-differential misclassification of outcome and job status.

In summary, we observed among nurses with prevalent doctor-diagnosed asthma, a statistically significant association between OR nursing, as compared to administrative nursing, and likelihood of severe persistent asthma. Although our results require cautious interpretation due to small sample size issues, they are consistent with the hypothesis that working as an OR nurse may induce more severe asthma or worsen asthma control. Further studies with precise information on both relevant exposure periods in relation to asthma activity and lifetime exposure estimates to various hazards, such as disinfectant/cleaning agents, anaesthetic gases, latex gloves, and work-related stress, are warranted among OR.

Acknowledgments

Source of Funding:

This study was funded by research grants CA-87969, HL-63841, and AI-52338 from the National Institutes of Health (Bethesda, USA).

The Nurses' Health Study is coordinated at the Channing Laboratory, Brigham and Women's Hospital, Boston, MA. We acknowledge the dedication and hard work of all of the Nurses' Health Study staff, especially Gary Chase, Karen Corsano, and Barbara Egan. We are grateful to all of the women who participate in the Nurses' Health Study for their contribution to the research.

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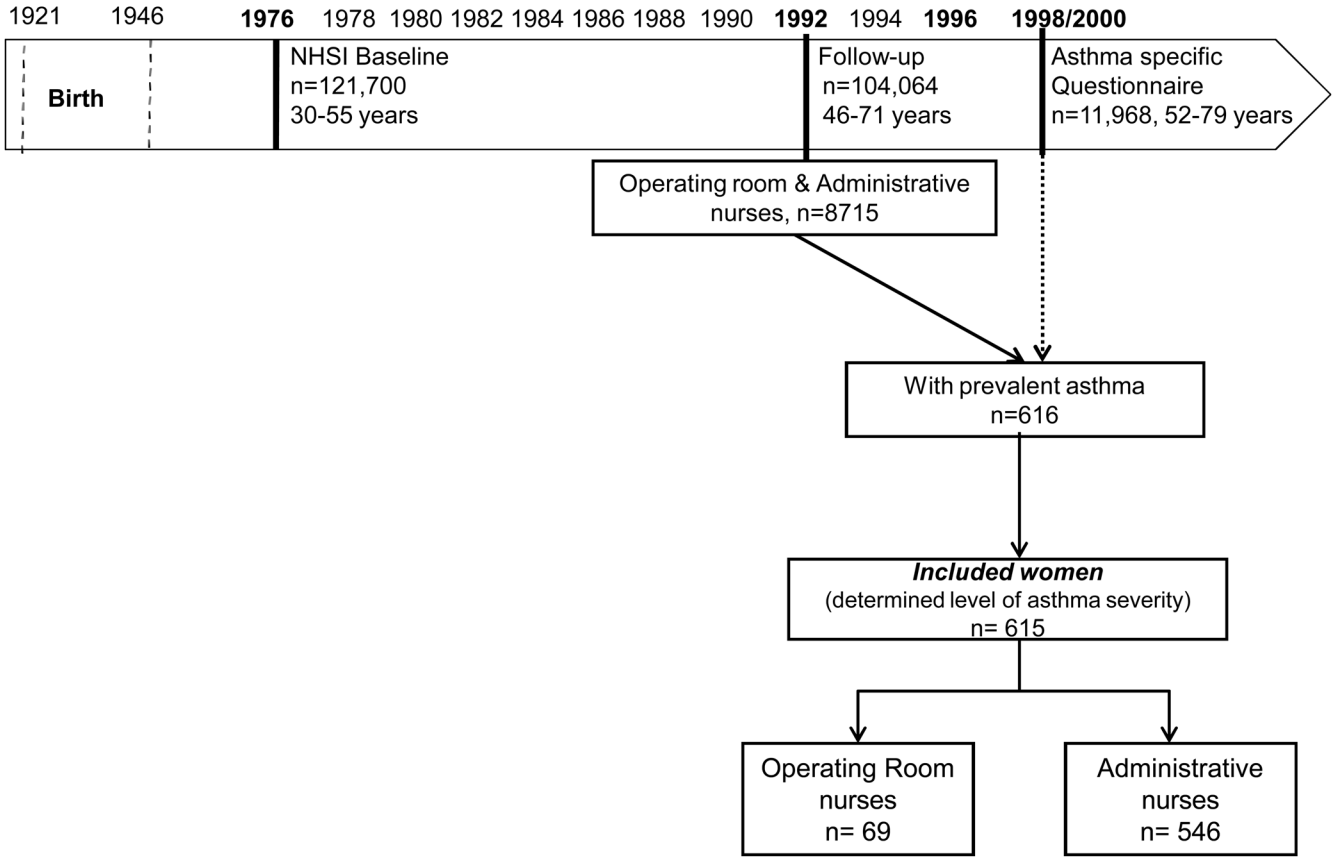

Figure 1. Flow chart of the studied population

To assess the cross-sectional association between reported employment as an Operating Room versus administrative nurse (in 1992) and asthma severity/control, among women with doctor-diagnosed prevalent asthma (1998/2000)

'Asthma prevalent definition ': participant reiterated on the asthma supplementary questionnaire (1998/2000) that a physician had diagnosed her as having asthma, and she reported using an asthma medication since diagnosis

Table 1

Baseline characteristics of operating room and administrative nurses in the Nurses' Health Study, 1992 (n=615)

	Operating room nurses (n=69)	Administrative nurses (n=546)
Age, in 1992 (years), mean (SD)	53 (5)	54 (5)
White race/ethnicity (%)	97	97
Menopausal status (%)		
Pre	32	23
Post	68	77
Smoking habits (%)		
Never smokers	41	41
Former smokers	46	46
Current smokers	13	13
Body mass index (kg/m^2), mean (SD)	27 (5)	28 (6)
Body mass index (kg/m^2) (%)		
<20.0	1	3
20.0–24.9	39	32
25.0–29.9	25	31
≥30.0	28	28
Missing	7	6
Physician examinations (%)		
No physician visits	4	10
Screening visits	54	67
Symptom-related visits	41	22
Missing	1	1

Table 2

Description of the respiratory symptoms in operating room and administrative nurses with asthma, Nurses' Health Study, 1998 (n=615)

	Operating room nurses	Administrative nurses	p value
n	69	546	
Age, in 1998 in years, mean (SD)	59 (5)	60 (5)	0.10
Age doctor first diagnosed asthma in years, mean (SD)	35 (19)	38 (19)	0.21
Within the past 12 months (%)			
Admitted to stay overnight in hospital because of asthma	3	2	0.78
Hospital ER for treatment of your asthma	7	5	0.33
Doctor's office/clinic for urgent treatment of your asthma	31	20	0.03
Days kept from work or usual activities	40	30	0.09
Symptoms over the past 4 weeks (%)			
Wheezy or whistling sound in chest			
Never	43	38	
<1/week	22	25	
1–3/week	11	16	0.73
4–6/week	6	7	
Daily	18	14	
Shortness of breath			
Never	47	34	
<1/week	17	26	
1–3/week	8	17	0.06
4–6/week	5	7	
Daily	23	16	
Cough			
Never	33	30	
<1/week	18	19	
1–3/week	23	16	0.43
4–6/week	9	8	
Daily	17	26	
Breathing between asthma flares (%)			
No symptoms	47	43	
Some symptoms on some days	30	40	0.11
Some symptoms on most days	9	11	
Symptoms most of the time, requiring an inhaler for relief	14	6	

Detailed information regarding asthma was obtained from the supplementary asthma questionnaire from 1998/2000.

Table 3

Association between type of nursing and asthma severity, 1998, Nurses' Health Study (n=615)

	Administrative nurses	Operating room nurses						
			Unadjusted		Adjusted[1]		Adjusted[2]	
	n	n	OR	95%CI	OR	95%CI	OR	95%CI
Mild intermittent	188	23	1.00	(ref)	1.00	(ref)	1.00	(ref)
Mild persistent	159	22	1.13	0.61–2.11	1.08	0.58–2.01	1.08	0.58–2.02
Moderate persistent	163	13	0.65	0.32–1.33	0.65	0.32–1.33	0.60	0.29–1.27
Severe persistent	36	11	2.50	1.12–5.57	2.72	1.21–6.12	2.48	1.06–5.77

Abbreviations: OR denotes odds ratio; 95% CI, 95% confidence interval; ref, reference.

Asthma severity was evaluated as previously published by Barr et al (17), in 4 classes (mild intermittent; mild, moderate and severe persistent), based on the 1997 National Institutes of Health asthma guidelines (18), and taking into account 'days per week with cough, wheeze, or shortness of breath during prior 4 weeks', symptoms between exacerbations and 'days prior year in which asthma interfered with work or usual activities'. According to current recommendations (19, 20) this definition of severity should be more labeled control or 'asthma severity/control'.

[1]Adjusted for age (in quantitative)

[2]Adjusted for age (in quantitative), Body mass index (in quantitative), Smoking habits (in 3 categories: never smokers, former smokers, current smokers)